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Technological unemployment and universal basic income: A scientometric analysis

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Abstract

The phenomenon of technological unemployment, long denied by neoclassical economic theory, has recently been taken seriously by a growing number of scholars, to the point that we can speak of a paradigm shift in economic diagnosis and prognosis. At the same time, a growing interest for universal basic income, as a possible solution for mass unemployment, is observable. This article assumes the perspective of the sociology of science and provides a diachronic scientometric analysis of scientific publications including these concepts. Quantitative and qualitative research tools are applied to the terms 'technological unemployment' and 'universal basic income', in order to reconstruct the dynamics of their Emergence, Frequency, Distribution, and Proximity (EFDP) in the scientific literature. This meta-research, by adopting a measure-driven approach, also tentatively explores the magnitude of alternative terms used to signify the same concepts and their EFDP dynamics.

Keywords: Technological unemployment, Universal basic income, Scientometrics, Topical Analysis, Conceptual analysis, Sociology of science.

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Background, Aim, and Methods of the Research

In scientific works, statements asserting the growth of interest in a topic are frequent. These statements are generally based on impressions. These impressions could be generated by a specific situation inside the researcher's department, by a trend on the journal on which the researcher usually publishes, by a growing number of lectures on that topic in conferences usually attended by the researcher, or by extra-scientific factors such as the media coverage of the topic. These impressions, based on partial observations or on intuition, are sometimes correct. However, the use of scientometric tools may produce a more grounded assessment of the issue. It is true that even quantitative meta-analytic approaches are not necessarily precise, because databases themselves contain mistakes. Nonetheless, it is advisable to support statements about research trends by means of quantitative topical analysis or by quoting an already existing study.

These considerations apply also to the ideas of 'technological unemployment' and 'universal basic income'. The first represents a social disease, while the latter is always more often indicated as its possible cure. Indeed, many experts now warn that we are on the verge of a new technological revolution which will revolutionize work. They maintain that Artificial Intelligence and smart robots will replace workers and produce technological unemployment on an unprecedented level so that universal basic income could be the only solution to avoid the collapse of society. This situation is often presented as new, and there is no doubt that the so-called 'fourth industrial revolution' (Schwab, 2017), or 'second machine age' (Brynjolfsson; McAfee, 2016), shows features that cannot be found in previous technological revolutions. However, the concept itself of 'technological unemployment' has a long history, which predates the birth of the term that signifies it (Campa, 2018). The same can be said as regards 'universal basic income'.

The aim of this research is to reconstruct the diachronic performance and the interplay of these two terms-and-concepts in the scientific literature, by taking the perspective of the *sociology of science* and by using research tools offered by *scientometrics*. As is well known, at its very beginning, scientometrics focused almost exclusively on citations and impact factor (Garfield, 1955), and this is still the main focus of the discipline. Among scientometrics' research lines, one finds the following ones:

> to understand scientific citations; how to measure scientific impact, including that of researchers, journals, and institutions; how to compare scientific disciplines from a Scientometrics standpoint; and what kinds of indicators should be used in assessment, policy, and management of research" (Cantu-Ortiz, 2018, p. 4).

However, with time, this discipline enlarged its range of analysis to virtually anything that is measurable in the scientific process. Indeed, "Scientometrics also permits studies about research collaboration, hot research topics, research trends, patenting, funding, and other related topics" (*Ibid.*, p. 5).

Here we provide an example of a scientometric analysis focused on research topics and trends, and more precisely on the quantitative occurrence of specific terms and concepts. Our aim is to reconstruct the dynamics of the Emergence, Frequency, Distribution, and Proximity (EFDP) of the terms 'technological unemployment' and 'universal basic income' in the scientific literature. The EFDC dynamics of equivalent terms will also be tentatively explored.

The perspective of both the sociology of science and scientometrics is inherently meta-analytical. Therefore, the first step is to choose an appropriate meta-analysis technique. There are at least three different ways of searching and collecting metadata on publications: 'traditional hand search', 'concept-driven search', and 'measure-driven search'. We will not spend much time to explain the first way since it is the one adopted by most researchers looking for secondary literature. The second and third ways need some clarification.

> The 'ideal type' concept-driven search model is comprised of two main stages. First, sources are identified using a keyword search in bibliographic databases, complemented with searches in literature reviews, consultations with experts, and searches of highly-relevant journals. The researcher then evaluates this initial set of publications for study eligibility. Second, additional sources are identified through searches of the bibliographies of coded publications. (Roelfs *et al*., 2013)

This approach is now commonly used and is less time-consuming. Besides, as Huedo-Medina *et al*. (2006) underline, adherence to a concept-driven approach lowers the dangers of introducing heterogeneity. This approach rapidly produces closure, by suggesting that the literature has been exhausted. However, this exhaustiveness is only apparent. Roelfs *et al*. (2013) have actually demonstrated that the measure-driven search model yields approximately six times as many coded publications as the concept-driven search model.

The measure-driven model draws from the insights of qualitative sociological methods. As many methodologists of sociology noticed, what is important is approaching the research with an open mind. This means that the researcher benefits from being capable of using the collected data in order to refine the subsequent analysis and search procedures (Glaser; Strauss, 1967, p. 33; Strauss; Corbin, 1990; Burawoy, 1998, p. 16).

The search starts exactly as the concept-driven approach, that is by designing keyword search algorithms based on different combinations of the terms. However, in the measure-driven approach, after the first phase, the search proceeds with a scrutiny of the relevant position retrieved. By reading the titles, the abstracts and the bibliographies, it is possible to understand which works are relevant to our research and which are not. Those that appear to be relevant must be carefully read. The goal is to find different ways (terms, expressions, phrases) to signify the same concepts. Then, a second 'wave' of database search should start, by using different terms. As Roelfs *et al*. (2013) put it, at this stage,

> the researcher uses an iterative search process to exhaust the literature of multiple sub-fields rather than that of the researcher's sub-field alone. Each iteration of searches through bibliographies, citing articles, and similar articles constitutes what we call a search "wave." Search waves are repeated until no additional sources emerge. With each wave, the search results are carefully scrutinized in an effort to capture alternative concepts of which the researchers may have been initially unaware. Our search method then utilizes this expanded theoretical framework to guide subsequent literature searches.

As one can see, this approach constitutes a compromise between the concept-driven search and the traditional hand search. Since, the measure-driven approach encourages eligibility criteria which are not a priori conceived, but rather organically developed, one cannot predict how many relevant positions will be eventually found. It must be underlined that this second approach is more precise, possibly exhaustive, but also more time-consuming. After implementing their own method, Roelfs *et al*. (2013) notice that the measure-driven approach "requires a great deal of effort and conceptual flexibility." Eight different waves were necessary to complete a search and "each wave took an average of three months for two coders, working 10 weekly hours, to complete." The proponents of this method recognize that "in a world of limited resources (in terms of both time and money) it is not always realistic to expect researchers to fully follow the procedure we have suggested." For this reason, we have limited the search waves to the number of two for 'technological unemployment' and three for 'universal basic income', which seems appropriate given the scope and the parameters of this paper.

As regards research tools, to determine the emergence and the frequency of our terms, we will initially search them by mean of *Ngram Viewer* by Google. To represent the frequency dynamics we will simply extract the graphs provided by that online tool, setting the period on the interval 1900-2008. As one will see, 'traces' of these terms can be found

also in the 19th Century, but we decided to leave out that period for two reasons. On the one hand, these traces are statistically irrelevant, on the other hand, their presence is often due to mistakes of the search tool. When searching a term in periodicals, *Ngram Viewer* tends to identify the foundation date of the magazine or the scholarly journal, rather than that of the issue. The term may actually appear on a 1930 issue, while it is located half a century before on the graph. That is why the typical qualitative analysis of the history of ideas is still needed when it comes to determining the actual emergence of a concept. *Ngram Viewer* does not provide data after 2008, because after that year the database is still largely incomplete. The scan of all books and periodicals is a work-in-progress.

Therefore, a search for data relative to the interval 2008-2018 will be performed on *Google Scholar*. As is well known, this database is less selective than *Scopus* or *Web of Science*. Sometimes it includes works that are not strictly scientific in character. However, by working on a larger number of items, this tool provides a good measure of the penetration of ideas in the scientific community and in the grey area that surrounds it. If data extracted from *Scopus* and *Web of Science* are of particular significance for academic bureaucracy, for instance, to assign research funds or to structure careers, data extracted from a more receptive database such a Google Scholar seems to be of major significance from a sociological point of view. Traditionally, the sociology of science considers the propagation and reputation of ideas more relevant than their inner validity (which is a matter left to philosophers and scientists).

On *Google Scholar*, we will collect data concerning the last decade (2009-2018) and will use them to reconstruct the annual distribution of publications containing the terms and the 10-year trend of their state of proximity. On this interval, we will work with absolute numbers, rather than relative frequencies, because – as we will show – the global scientific production was rather stable in the last ten years, with a magnitude of

scientific works around four million per year (the only exception is the year 2018, when detected scientific publications were more than five million). Graphs and diagrams will be crafted in *Excel*.

A final note about language is perhaps necessary. Our research focuses on the scientific literature in the English language, and on those works having at least titles, abstracts or keywords translated into the English language. This is a wide but still limited sample of the global population of scientific works. However, nothing prevents other researchers from applying this method to the study of literature in other languages.

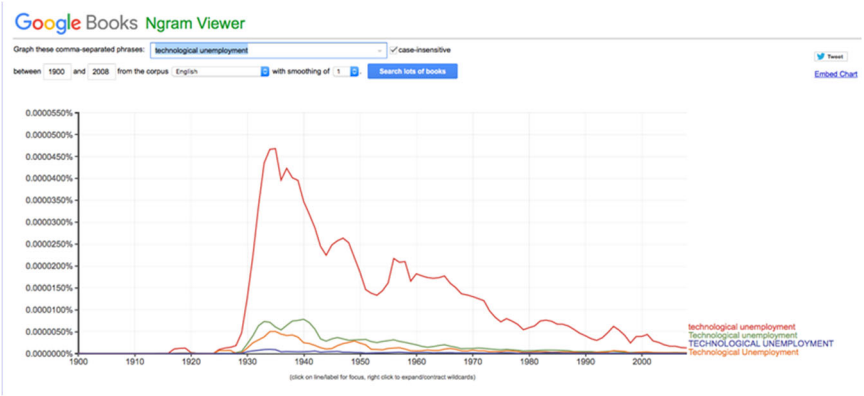
A Scientometric Analysis of the term 'Technological Unemployment'

The idea that machinery can replace workers and cause a phase of prolonged or permanent unemployment is as old as the industrial revolution. For instance, we can find it in 19th-century economic literature and, especially, in the works of David Ricardo (1821) and Karl Marx (1867). Still, a conventional name for this social disease has been adopted by economists only in the first half of the 20th century. As is well known, this name is 'technological unemployment'. A search in *Ngram Viewer* shows that the occurrences of publications including this term take off around the year 1930, even if – as one can see from Graph 1 – the term already existed before that year.

It is not the goal of this research to establish who was the scholar who coined the term, but rather to identify the moment when the term emerged and took momentum. In-depth qualitative research reveals that the items identified by the *Ngram Viewer* before 1920 are misleading. This is the case of the occurrence in the *Engineering Extension Bulletin*. As sometimes happens, the date of the foundation of the scholarly journal was identified (1919), rather than the actual date of the issue (1946). Still, the use of the term in 1928 can be documented. On that year, Paul H. Douglas published an article on the *Labor Bulletin* entitled "Are we suffering from technological

unemployment?" (Douglas, 1928). The occurrence of the term is documented also in 1929, when Marxist economist Jürgen Kuczynski published an article entitled "'Technological' Unemployment" (Kuczynski, 1929) in the volume *Trade Unions Study Unemployment*, edited and published by the American Federation of Labor. The use of this term-and-concept spread very rapidly in the biennium 1930-31 and reached its peak in 1935.

Graph 1: Emergence and relative frequency of the term "technological unemployment" (1900-2008)



There is a general consensus on the fact that the article *Economic Possibilities for our Grandchildren*, published in 1930 by John Maynard Keynes, gave a significant contribution to the success of the term 'technological unemployment'. Keynes' article is still often quoted today and currently collects almost two thousand citations. The author projects himself a hundred years into the future and tries to imagine the world of his grandchildren. In the midst of the Great Depression, while everything seems to fall apart, the British economist gives himself the uncomfortable task of making a declaration of optimism. The economic data are all negative, companies fail, millions of people fall into the hell of unemployment, yet the warehouses are full of goods, people want to work, traders would like to sell

and customers to buy. The crisis does not concern the real economy. It concerns the castle of financial cards that was built over the real economy and that starts to appear of dubious usefulness. So, according to Keynes, when humans will come to their senses and understand the mistakes they have made in managing the economy, everything will be fixed. Technological unemployment itself, which seems to be a disgrace, is actually the announcement that a better world is emerging on the horizon, a world in which it will no longer be necessary to work (or at least not so hard) in order to survive. Here are his own words:

> We are being afflicted with a new disease of which some readers may not yet have heard the name, but of which they will hear a great deal in the years to come – namely, technological unemployment. This means unemployment due to our discovery of means of economising the use of labour outrunning the pace at which we can find new uses for labour. But this is only a temporary phase of maladjustment. All this means in the long run that mankind is solving its economic problem. (Keynes 1963, p. 325)

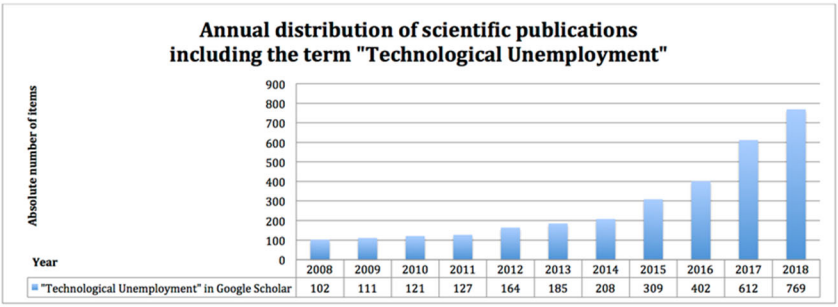
According to Keynes, machinery paves the way for a drastic reduction of the working hours, or even for the abolition of work. He foresees an age of leisure and abundance. However, since total idleness could bring unwanted side effects, Keynes (1963, p. 369) suggests that "we shall endeavour to spread the bread thin on the butter – to make what work there is still to be done to be as widely shared as possible. Three-hour shifts or a fifteen-hour week may put off the problem for a great while."

We are close to the year 2030 and mankind did not solve yet its economic problem. In industrial countries, we still work the same amount of hours, and a consistent percentage of people are unemployed or underemployed. Graph 1 shows that the idea of technological unemployment itself, from 1930 to 2008, experienced a constant decline. So, it is no surprise that there were no concrete attempts to drastically

reduce working hours. Neoliberalism has replaced Keynesism, in theory and practice. In Europe, the keyword of economic policies is now 'austerity', rather than 'leisure and abundance.'

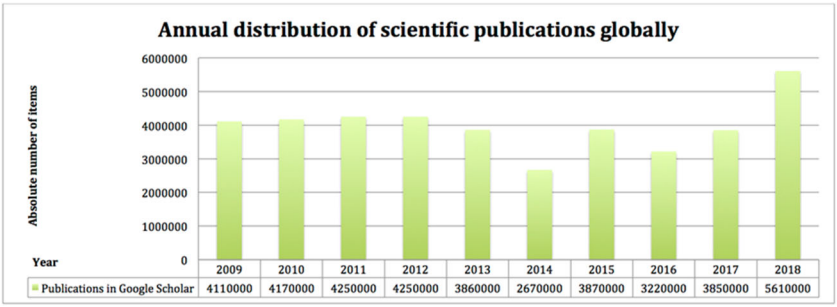
Nonetheless, if we look at the most recent data, it seems that a 'technological unemployment' renaissance in scientific literature is on the way. The distribution of publications including this term, in the last decade, leaves little doubt (see Graph 2).

Graph 2



Here, on the x-axis, one finds the absolute number of items, rather than the relative frequency. However, we can exclude that the increase of publications including the term could be due to the global growth of publications since in the interval 2009-2018 they were more or less constant. As one can see in Graph 3, they are around 4 million per year, with the exception of a peak of more than 5 million in 2018. It is quite significant that the absolute number of publications including the term 'technological unemployment' increases even when the global number of publications detected by *Google Scholar* shrinks, as it happens in 2014 and 2016.

Graph 3



This paradigm change has already been analyzed from a qualitative point of view (Campa, 2014, 2017). However, a question may arise about the correspondence between economic theory and reality. Is the virtual disappearing of the term 'technological unemployment' from economic theory in the second half of the 20th century due to the disappearing of the corresponding phenomenon, or to a 'fashion change' among scientists? This is an old epistemological problem that has no easy solution. Marginalist (or neoclassical) theory has dismissed the idea of technological unemployment as 'the Luddite fallacy'. In particular, influential economists, such as Knut Wicksell (1977, p. 140) and Joseph Schumpeter (2006, p. 652) concluded that technological development is never the cause of unemployment, and this fallacious causal association is due to the lack of mathematical knowledge which afflicts many economists. Once this narrative became hegemonic, it is understandable that most economists were reluctant to use the term in their theorizing. But, if the corresponding phenomenon was to some extent perceived as real, or – in other words – if a certain number of economists were still persuaded that automation was responsible for at least a portion of the unemployment rate, then a different term had to be used to signify the concept. By reading scientific works published in the interval 1930-2008, one may find out that, indeed,

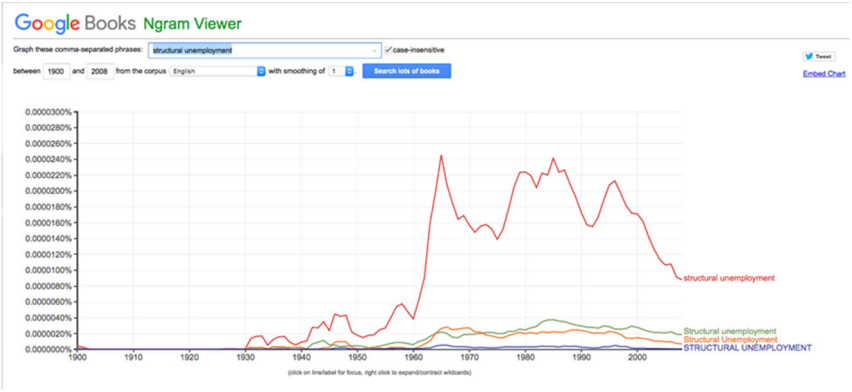
other terms were used to establish a causal relation between automation and unemployment. For instance, a term such as 'structural unemployment' was often preferred. An example is the book *Promises Kept: John F. Kennedy's New Fr*ontier by Irving Bernstein.

> During the 1950s American industry introduced automatic machine controls (machines that instructed other machines) in order to increase efficiency, cut cost, and display labor. This came to be called "automation." […] Coal miners, textile workers, steel workers, longshoremen, and meat packers who lost their jobs blamed "automation." By this they meant what labor market economists were now calling structural unemployment. (Bernstein 1991, p. 160)

Bernstein underlines that "this was the most complex type of joblessness", because it had many causes. Among the many causes, there is "technological change which displaced labor without providing alternative employment." Even Keynesian fiscal and monetary policies could not eradicate completely this malaise, so much so that Bernstein concludes that "structural unemployment tended to be especially prolonged and intractable" (*Ibid*.).

It is important to emphasize that 'structural unemployment' is not exactly equivalent to technological unemployment because it indicates a complex multicausal phenomenon. The meaning 'structural unemployment' conveys is more extensive and, therefore, less precise. In a sense, technological unemployment is just a type of structural unemployment. But since the synecdoche is a recurring rhetorical figure also in scientific literature, it can be useful to have a look at the frequency of publications containing this term in the interval 1900-2008, on *Ngram Viewer*. In other words, it is time for the second search wave of our measure-driven approach.

Graph 4: Emergence and relative frequency of the term "structural unemployment" (1900-2008)

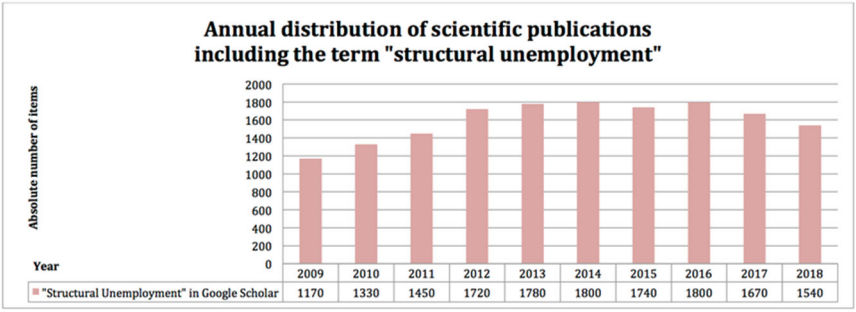


As one can see in Graph 4, the term 'structural unemployment' encounters the first peak in the mid-1960s. Then, after a slight temporary drop, its occurrence is constantly high in the whole 1980s. This is the period when the full robotization of the car industry and the massive introduction of computers in offices took place.

By using this term, economists may have recognized the actual displacement of jobs in concomitance with technological change, but without pointing directly the finger to technology. This way they could discuss the problem, without being accused of indulging in the Luddite fallacy. For instance, structural unemployment has often been linked to the lack of adequate education among unemployed people. The productive world is constantly changing, getting more and more technologically advanced, and a portion of people cannot fit in it, for lack of appropriate knowledge of the industrial processes. On this point, I allow myself an observation. This may be true, but since public education is fundamentally a therapy, it can never be the ultimate cause of the illness. Following the same logic, one may conclude that people contract an infection for lack of medicines, ignoring the fact that the primary causes of infections are pathogens, such as viruses and bacteria.

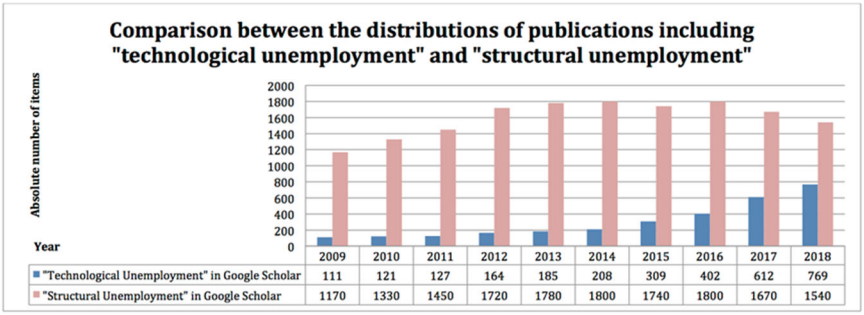
The annual distribution of scientific publications including the term 'structural unemployment' in the interval 2009-2018 (Graph 5) shows that because of its semantic extension, this term is used much more than 'technological unemployment'.

Graph 5



Still, quite interestingly, a decrease in the absolute number of items is clearly observable in the last years of the decade. In the year 2009, the term 'structural unemployment' was used circa ten times more than 'technological unemployment', while – as Graph 6 shows – ten years later the occurrences of the first term only double those of the second one.

Graph 6



A Scientometric Analysis of the term "Universal Basic Income"

Since the Neolithic revolution, if not before, on this planet there is a minority of people that live off rental income and a majority of people that work to survive. To solve the problem of inequality, progressive thinkers have usually proposed the elimination of the parasitic classes (being these the aristocracy, the clergy, or the bourgeoisie). The idea that "everybody should work" is not, however, the only solution proposed to overcome social injustice. An alternative proposal emerging in the history of ideas is that "everybody should live off rental income." This idea has been treated for a long time as a mere utopia. Nonetheless, with the complete automation of factories, the proposal of abolishing work – while remaining a futuristic idea – has encountered growing popularity. The frequency of the term 'universal basic income' in scientific literature, in the interval 1900-2008, is shown in Graph 7.

Graph 7: Emergence and relative frequency of the term "universal basic income" (1900-2008)

A careful reading of the literature shows that different meanings are attached to the term 'universal basic income'. Some researchers speak of "universal basic income for the elderly" (Society of Actuaries, 1970, p. 337), which is a concept close to that of 'social pension" or 'non-contributory pension'. Other researchers speak of "universal basic income support for the poor" (Luft, 1978, p. 236), which is just another word for 'unemployment benefit' or 'income support.' However, in dictionaries and encyclopedias, a universal basic income is an "unconditional income paid to all members of society" (Birnbaum 2016).

In 1960, American sociologist Maurice Parmelee, in his magnum opus *The History of Modern Culture*, describes a socialist view of the future in the following terms: "The basic distribution will take place regardless of the organization of work. That is to say, a high standard of living will be assured to all citizens of the socialized commonwealth irrespective of what productive function they perform. Whatever is produced over and above this universal basic income will be distributed equally or differentially as may seem desirable at different times" (Parmelee, 1960, p. 733).

A similar utopian vision was elaborated by American historian and futures studies scholar Walter Warren Wagar, in his book *Building the City of Man*. Our keyword is found in the following fragment:

> Given the legitimate demands of a large world population on the material resources of the planet, our commonwealth will prohibit net personal incomes more than four times greater than the guaranteed universal basic income. Any surplus earned will be taxed at the rate of one hundred percent (Wagar 1971, p. 147).

The idea of all citizens receiving regular payments (dividends) from revenue raised by taxing the automated industries finds more supporters in the 1980s when industrial robots peep into the factories and the mass sacking of the industrial workers begins. Particularly active on this front is political economist Hermione Parker, co-founder of the British Basic Income Research Group.

A calculation of the costs of universal basic income is provided by Parker in her work *Action on Welfare* (1984). This work is quoted by J. Hemming, in 1986 book *Instead of God?: A Pragmatic Reconsideration of Beliefs and Values*, as follows: "The cost of providing a universal basic income for every man, woman and child is less than might be supposed. Hermione Parker has calculated that the Basic Income Guarantee (BIG) scheme could be sustained by direct taxation of 40% at the lower end (45% of average earnings…". Parker and her research group are, however, convinced that their proposal cannot be successful in an era – the 1980s – dominated by neoliberal economics. Still, they hope that the 1990s will bring a new sensitiveness. In their 1991 report *Basic Income and the Labour Market*, they conclude that

> [a]n unconditional, universal BI would promote self reliance in a way that means-tested benefits can never achieve. Economic and ideological developments weakened the case for universalism during the 1980s, but today there are signs that public opinion found untrammelled Thatcherism repugnant (Parker 1991, p. 49).

Indeed, as Graph 7 shows, the universal basic income proposal takes a decisive share in the 1990s and gain momentum at the beginning of the third millennium, when robots and computers expand beyond the factories and invade the service sector. We just provide a few examples. In his 1998 book *The New Politics of Welfare*, social work scholar Bill Jordan writes that "there could be a universal basic income for every citizen of the EU, equivalent to the lowest level affordable by the poorest country, and each wealthier nation state could supplement it by a national basic income of its own…" (Jordan, 1998, p. 226).

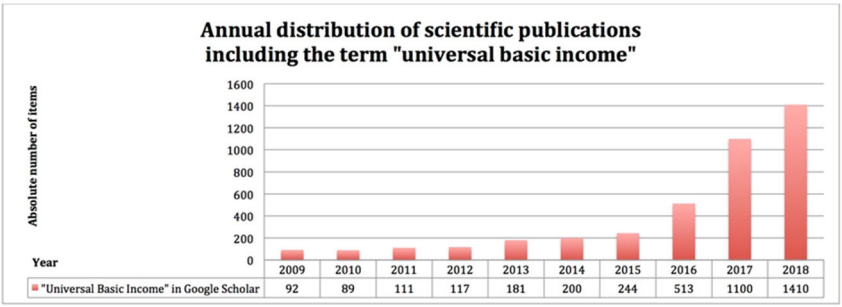
The idea of universal basic income finds space also in feminist thinking. In a 1998 article entitled "Women and Social/Economic Policy: New feminist agendas for changing times?", Christine Cheyne and Celia

Briar state that "with some adjustments for special needs, a universal basic income could act as a family benefit, student grant, caregivers' allowance, sickness and invalid benefit, tax-free allowance for employees, and retirement pension." (Cheyne; Briar, 1998).

An especially fertile ground for the idea of universal basic income is the sociological community, perhaps because sociology, more than any other disciplinary area, focuses on the problems of inequality, social injustice, and class stratification. In the year 2000, a plea for universal basic income can be found in Erik Olin Wright's article "Reducing Income and Wealth Inequality: Real Utopian Proposals," included in a special issue of *Contemporary Sociology* entitled *Utopian Visions: Engaged Sociologies for the 21st Century*.

As one can see from Graph 8, Parker's hopes were well placed. The interval 2009-2018 is characterized by the exponential growth of the occurrence of the term 'universal basic income' in the scientific literature.

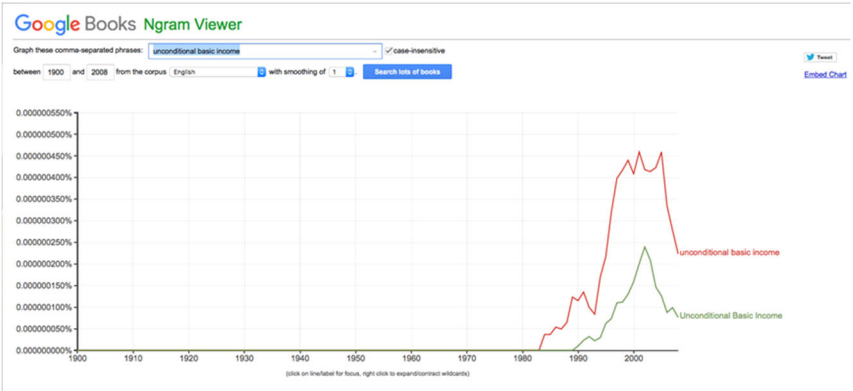
Graph 8



And this is only the tip of the iceberg. By examining in detail the literature accessible via *Google Books* and *Google Scholar*, it becomes evident that not only different concepts are signified by the same term, but also different terms are used to signify the same concept. Among these terms,

one may find the following ones: "Unconditional Basic Income," "Basic Income Guarantee," "Citizen's dividend," "Citizen's Income," "Citizen's Basic Income," and many others. In a measure-driven approach, a search wave for every single term should be implemented to achieve a complete picture of the concept's dynamics. However, this would produce material for a book, rather than for an article. Since scientometrics may work with samples, and not necessarily with entire populations, we will just perform two more search waves, to check if they confirm the trend already detected by the first one. The second term we decided to search on *Ngram Viewer* is 'unconditional basic income'.

Graph 9: Emergence and relative frequency of the term "unconditional basic income" (1900-2008)

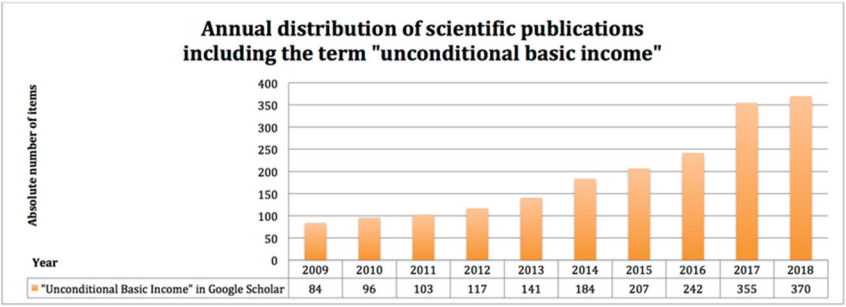


As one can see from Graph 9, the emergence of the term is located in the mid-1980s. It emerges a couple of decades after the birth of the term 'universal basic income'. Since the second term was sometimes used to signify a social pension for the elderly or a social benefit for the poor, perhaps researchers felt it necessary to emphasize the fact the basic income must be delivered independently of any social condition, including age or

economic status. Anyway, Graph 9 confirms the trend already envisioned in Graph 7. There is a growing awareness about the need for a basic income starting at the end of the 1980s, which reaches a peak around the year 2000 and then encounters a flexion. Probably, the year 2000, because of its millenarian and apocalyptic significance, favored utopian speculations about the future.

What happens in the last decade? Graph 10 confirms the growth of interest in this topic in the scientific community.

Graph 10

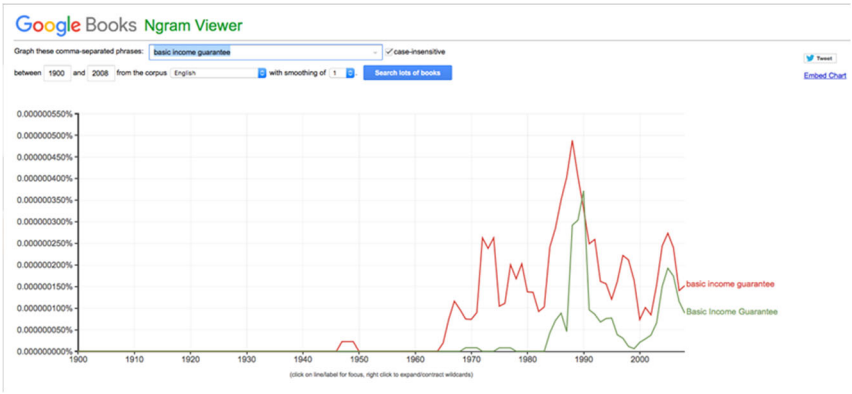


It can be noticed, however, that the growth of literature on 'unconditional basic income' is less pronounced than the growth of literature on 'universal basic income'. To have a more precise idea of the global growth of interest in this topic, one should sum all the publications including all the terms equivalent to 'universal basic income', but with the caution of avoiding counting twice the items that include more than one term (for instance both "basic income guarantee" and "citizen's income"). This operation would imply reading thousands of works.

While a simple aggregation of occurrences may contain a certain degree of error, it would still give an idea of the general trend. Let's add the term 'basic income guarantee' to our analysis. This would be our third

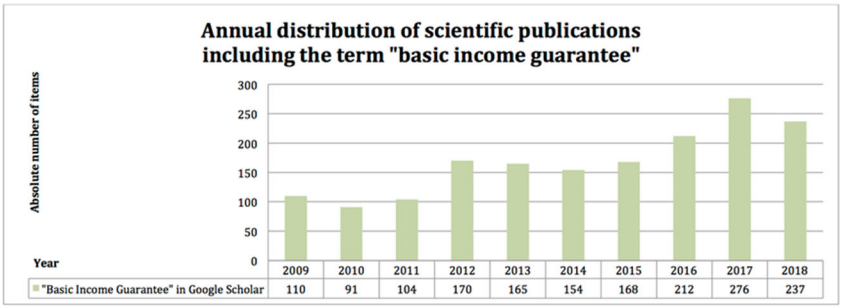
search wave. In Graph 11, one may see the emergence of the term and its frequency in the interval 1900-2008.

Graph 11: Emergence and relative frequency of the term "basic income guarantee" (1900-2008)



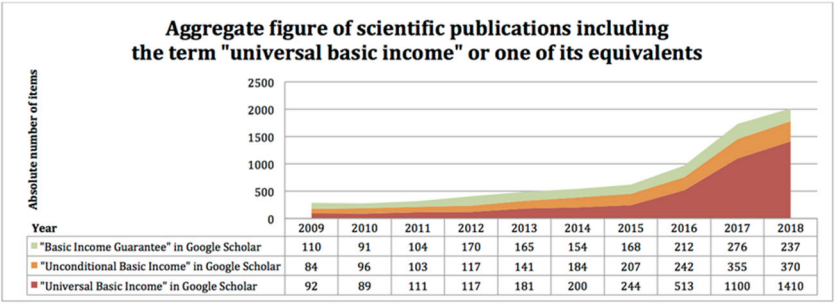
Graph 12 shows the distribution of scientific publications including the term 'basic income guarantee' in the last decade. As one can see, even in this case we register a tendential increment, but with no recognizable curve.

Graph 12



Finally, Graph 13 shows the aggregate figure of the three distributions. The absolute number of items including one of these terms keeps increasing. Still, the term 'universal basic income' remains the most trendy one.

Graph 13



Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
"Basic Income Guarantee" in Google Scholar	110	91	104	170	165	154	168	212	276	237
"Unconditional Basic Income" in Google Scholar	84	96	103	117	141	184	207	242	355	370
"Universal Basic Income" in Google Scholar	92	89	111	117	181	200	244	513	1100	1410

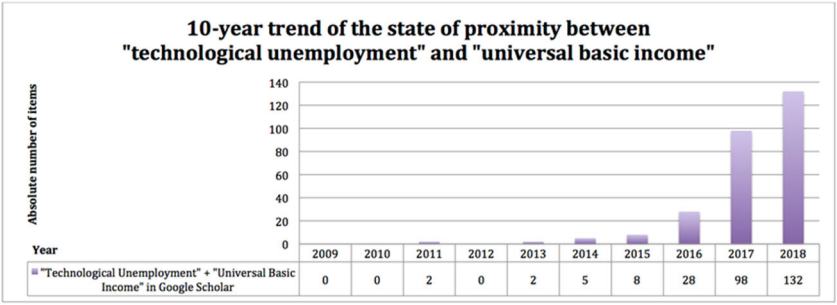
The spread of this concept in recent years is impressive, without considering that it would be much higher if one would include in the calculation also terms in languages other than English, such as the Italian "reddito di cittadinanza" or "reddito universale di base," the French "revenu universel de base" or "revenue de base inconditionnel," the Spanish "renta básica incondicional" or "ingreso básico universal," the German "Universelles Grundeinkommen" or "bedingungslosen Grundeinkommen," and many more.

A Scientometric Analysis of the state of proximity between 'Technological Unemployment' and 'Universal Basic Income'

A growing number of experts include in their analyses both terms 'technological unemployment' and 'universal basic income', even if the stated relations between the concepts may differ. First of all, by using scientometric tools we will detect the 10-year trend of the state of proximity

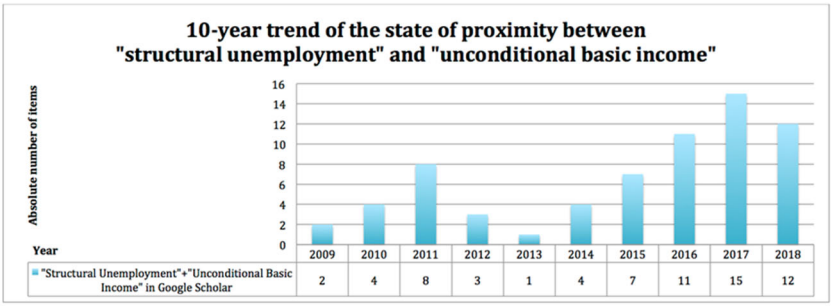
between the two terms. By 'state of proximity' we simply mean the compresence (or togetherness) of both terms in the same publication.

Graph 14



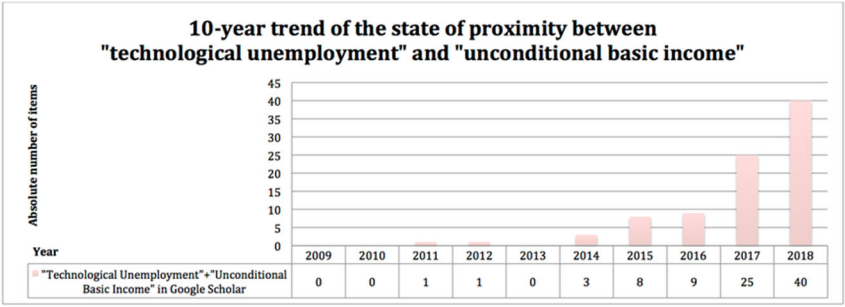
As one can see in Graph 14, the growth almost follows an exponential curve. In the first four years of the decade, there are virtually no publications including both terms together. Starting from 2013 one may observe an impressing change. The same cannot be said if we check the 10-year trend of the state of proximity between the alternative terms 'structural unemployment' and 'unconditional basic income'.

Graph 15



As graph 15 shows, growth is still visible, but not linear nor exponential. The outcome of this combination seems to be due to the underperformance of the term 'structural unemployment', which – as we have seen – is in decline in respect to his older and more precise rival 'technological unemployment'. Indeed, if we check the state of proximity between this last term and 'unconditional basic income', we observe once again a curve that resembles an exponential growth (see Graph 16).

Graph 16



Obviously, a state of proximity does not tell much about the actual theoretical relations between the two concepts. An author could in principle discuss both concepts in order to refute their validity, from the perspective of economic theory or social policy analysis. Nonetheless, there are many contributions that present universal basic income (or at least one of its forms) as a solution for a future condition of mass unemployment supposedly generated by technological innovation.

By moving from quantitative to qualitative analysis, we provide just a couple of examples. In 2014, the Institute for Ethics and Emerging Technologies (IEET) published a special issue of the *Journal of Evolution and Technology*, entitled "Technological Unemployment and Basic Income Guarantee" (Hughes, 2014). The special issue can be interpreted

as a call for the complete automation of the economy, to eventually free people from forced and alienated work. Leveraging on the threat of technological unemployment and, at the same time, emphasizing that we must see in robot and computer an opportunity rather than a danger, the contributors relaunch the idea of a universal basic income. The IEET is a technophile oriented organization and this is anything but irrelevant. In the past, the scholars denouncing the disruptive effect of automation have often been (wrongly or rightfully) accused of technophobia and pauperism. This accusation cannot certainly be moved against the researchers who habitually publish in the *Journal of Evolution and Technology*.

Other interesting examples are the recent works of Martin Ford. Author of two bestsellers on the topic of technological unemployment, The *Lights in the Tunnel* (2009) and *Rise of the Robots* (2016), Ford challenges the idea that better education, perhaps in technical and scientific disciplines, is still the best way to solve problems arising from automation. In his opinion, to meet the challenge of new technologies requires a dramatic political response, something really incisive, like a guaranteed income. More in detail, Ford explains that there are two general approaches to achieve this result. First approach: "An unconditional basic income is paid to every adult citizen regardless of other income sources." Second approach: "Guaranteed minimum incomes (and other variations, such as a negative income tax) are paid only to people at the bottom of the income distribution and are phased out as other income sources rise" (Ford, 2016, p. 261). As one can see, Ford also suggests using different terms to distinguish between the approaches: unconditional vs. guaranteed.

The second approach is less expensive, but dangerous, because it may produce "disastrous perverse incentives." According to Ford, universal basic income should never completely replace work income. It should be an addition to it, as it was in the experiment carried out in Finland in the

biennium 2017-2018 (Kangas; Simanainen; Honkanen, 2017). Giving a small amount of money to all citizens can revitalize the economy, without activating the vicious circle of poverty-welfare-poverty. Those who get up at six in the morning to reach the workplace must receive a total income much higher than that perceived by those who do not work at all if one does not want to encourage parasitism and create a new form of injustice.

Conclusions

With regard to the EFDP dynamics of 'technological unemployment' and 'universal basic income', our empirical research brings us to the following conclusions. The two terms appear in the 20th century to name preexisting concepts. Around 1930 we register the emergence of both terms 'technological unemployment' and 'structural unemployment'. Made exception for some isolated precocious uses, in the mid-1960s we register the emergence of 'universal basic income' and its many equivalents. As one could expect, the problem predates of almost four decades the emergence of its most utopian solution.

Our research shows that the now popular term 'technological unemployment' is a rediscovery. This expression is currently enjoying a second wave of popularity, after the one it gained in the 1930s. The Great Depression that followed the crash of 1929 could be reasonably seen as the main cause of its first wave of success.

During its decline, it was often replaced by the not exactly equivalent term 'structural unemployment'. However, both terms encounter their lower point in the year 2008. This is true also for the terms 'universal basic income' and its equivalents 'unconditional basic income' and 'basic income guarantee'. Their occurrence also drastically decreases and reach a lower point in the year 2008. Subsequently, the growth restarts and seems to be exponential. Besides, after this date, the terms 'technological unemployment'

and 'universal basic income' (and their equivalents) start interacting with growing intensity, as all the proximity surveys show.

What happened in 2008? The global financial crisis. We can, therefore, tentatively conclude that the two great economic crisis of the contemporary era are the main causes of the success of these two concepts, otherwise rejected respectively as fallacious and utopian by mainstream economics.

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